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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/609,240	06/27/2003	George J. Bennett	K35A1308	7742

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EXAMINER	
TZENG, FRED	

ART UNIT	PAPER NUMBER
2651	

DATE MAILED: 12/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/609,240	BENNETT, GEORGE J.	
	Examiner	Art Unit	
	Fred Tzeng	2651	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 June 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7, 11-18, 22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 June 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *6/27/2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-22 are presented.

Specification

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-7, 11-18, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mortazavi et al (USPN 5,838,515) hereafter as Mortazavi, in view of Duerbaum et al (USPN 6,711,034) hereafter as Duerbaum, and further in view of Rowan (USPN 5,986,426).

RE claim 1, Mortazavi discloses the invention substantially as claimed. Mortazavi discloses a disk drive (see column 5 line 16; disk drive 10) comprising: (a) a disk (see column 5 line 17; disk 14); (b) a head (see column 5 line 20; the head 20); (c)

a voice coil motor (VCM) for actuating the head radially over the disk, the VCM comprising a voice coil (see column 5 lines 21-22; the VCM 22 for actuating the head 20 radially over the disk 14, the VCM 22 comprising voice coil 24); (d) a plurality of driver switches for controlling a voltage applied to the voice coil (see column 1 lines 53-67 and column 3 lines 58-59; the DMOS power transistors are acting as switches and are connected to the coil 24 as an H-bridge for controlling a voltage applied to the voice coil 24); and (e) a pulse width modulated (PWM) signal generator for generating PWM control signals applied to the driver switches (see column 3 lines 21-25 and column 4 lines 8-12; the PWM generation circuit) comprising: a PWM cycle time (see column 3 line 23; the variable duty cycle).

However, Mortazavi does not specifically disclose that the PWM signal generator comprising: a Tforward time interval of the PWM cycle time wherein a positive control voltage is applied to the voice coil; a Treverse time interval of the PWM cycle time wherein a negative control voltage is applied to the voice coil; and a Tdead time interval of the PWM cycle time wherein a substantially zero control voltage is applied to the voice coil.

Duerbaum discloses an inverter, which functioned as a pulse-width modulated signal generator for producing pulse-width modulated AC voltage, featured by switching frequency and a duty cycle, while within each time interval whose duration is determined by the switching frequency, first a positive and then a negative voltage is generated or first a positive voltage and then a zero output voltage is generated for a period of time, wherein the duration of the positive voltage pulse is predefined by the

duty cycle and the duration for which the voltage is zero or negative is predefined by the rest duration of the interval (see column 4 lines 20-33). The duration time interval of the positive voltage pulse is Tforward time interval of the PWM cycle time. The duration time interval of negative voltage is Treverse time interval of the PWM cycle time. The duration time interval of zero voltage is Tdead time interval of the PWM cycle time.

Furthermore, neither Mortazavi nor Duerbaum discloses that the Tdead time interval is adjusted to control a magnitude of an actual ripple current flowing through the voice coil.

The limitation of that the Tdead time interval is adjusted to control a magnitude of an actual ripple current flowing through the voice coil is considered inherent because in column 3 lines 35-44, where Rowan discloses that the characteristics of the pulse width modulation (PWM) waveform are modified or adapted to allow tradeoffs to be made between lower noise emission, greater power efficiency, and current ripple in the motor in order to optimize the drive operation.

Mortazavi, Duerbaum and Rowan are combinable because they are from the same field of endeavor. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Mortazavi invention by including a PWM signal generator which comprising of Tforward time interval, Treverse time interval and Tdead time interval in order to regulate the symmetry deviation to zero as expressly taught by Duerbaum at column 4 lines 20-36 such that power utilized can be optimally maximized (see column 4 lines 37-48). And further modifying Mortazavi invention in view of Duerbaum invention by including the feature that the Tdead time

interval is utilized for adjustments for controlling a magnitude of an actual ripple current flowing through the voice coil in order to increase the power consumption efficiency of the VCM driver circuitry as expressly taught by Rowan at column 3 lines 35-44 (pulse width modulation waveform are modified to allow ripple current in the motor in order to optimize the driver operation).

RE claim 2, the limitation of that a first and second end of the voice coil are shorted to ground during the Tdead time interval is considered inherent because Duerbaum discloses that the during the duration time interval for which the voltage is zero (Tdead time interval), a zero output voltage is generated for a period of time (see column 4 lines 20-33).

RE claim 3, the limitation of that the Tforward time interval is computed in response to a target ripple current flowing through the voice coil is considered inherent because Duerbaum discloses that the duration of positive voltage pulse (i.e., Tforward time interval) is predefined by the duty cycle for power to be utilized optimally (see column 4 lines 20-48) while Rowan disclose that pulse width modulation waveform are modified to allow ripple current in the motor in order to optimize driver operation (see column 3 lines 40-41). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Rowan's pulse modulation waveform in view of Duerbaum's duration time interval of positive voltage pulse (i.e., Tforward time interval) in order to achieve the optimized driver operation.

RE claim 4, the limitation of that the Treverse time interval is computed in response to the Tforward time interval and the target ripple current is considered

inherent because Duerbaum discloses that the duration of positive voltage pulse (i.e., Tforward time interval) is predefined by the duty cycle and the duration for which the voltage is negative (i.e., Treverse time interval) is defined by the rest duration of the interval for power to be utilized optimally (see column 4 lines 20-48) while Rowan disclose that pulse width modulation waveform are modified to allow ripple current in the motor in order to optimize driver operation (see column 3 lines 40-41). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Rowan's pulse modulation waveform in view of Duerbaum's duration time interval of positive voltage pulse (i.e., Tforward time interval) and duration time interval of negative voltage pulse (i.e., Treverse time interval) in order to achieve the optimized driver operation.

RE claim 5, the limitation of that the Tdead time interval is computed in response to the Tforward and Treverse time intervals is considered inherent because Duerbaum discloses that the duration of positive voltage pulse (i.e., Tforward time interval) is predefined by the duty cycle and the duration for which the voltage is negative or zero (i.e., Treverse time interval and Tdead time interval) is defined by the rest duration of the interval for power to be utilized optimally (see column 4 lines 20-48).

RE claim 6, the limitation of that the Tforward and Treverse time intervals are adjusted proportionally in response to a current command is considered inherent because Duerbaum discloses that the duration of positive voltage pulse (i.e., Tforward time interval) is predefined by the duty cycle and the duration for which the voltage is

negative (i.e., Treverse time interval) is defined by the rest duration of the interval for power to be utilized optimally (see column 4 lines 20-48).

RE claim 7, the limitation of that the Tdead time interval is computed in response to a target ripple current and a measured ripple current is considered inherent because Duerbaum discloses that the duration for which the voltage is zero (i.e., Tdead time interval) is defined by the rest duration of the interval for power to be utilized optimally (see column 4 lines 20-48) while Rowan disclose that pulse width modulation waveform are modified to allow ripple current in the motor in order to optimize driver operation (see column 3 lines 40-41). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Rowan's pulse modulation waveform in view of Duerbaum's duration time interval of zero voltage pulse (i.e., Tdead time interval) in order to achieve the optimized driver operation.

RE claim 11, the limitation of that (a) the voice coil comprises a resistance R and an effective inductance L; (b) the effective inductance L is a function of the actual ripple current flowing through the voice coil; (c) the resistance R changes with temperature drift; and (d) the Tdead time is adjusted to maintain a substantially constant ratio L/R are considered inherent because Mortazavi discloses that the voice coil 24 comprises coil R and motor inductance L and the current flowing through the coil resulting voltage proportional to current in accordance with Ohm's Law (see column 7 lines 35-65). Also, Duerbaum discloses that the duration for which the voltage is zero (i.e., Tdead time interval) is defined by the rest duration of the interval for power to be utilized optimally (see column 4 lines 20-48). It would have been obvious to one having ordinary skill in

the art at the time the invention was made to modify Mortazavi invention in view of Duerbaum invention to adjust the Tdead time to maintain a substantially constant ratio L/R in order to achieve the optimized driver operation.

Claims 12-18, 22 are the method steps associated with the apparatus of claims 1-7, 11 and therefore are rejected on the same basis as the apparatus claims.

Allowable Subject Matter

5. Claims 8-10 and 19-21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is a statement of reasons for the indication of allowable subject matter: Claims 8-10 and 19-21 are allowable over the prior art of record because none of the prior art of record teaches or fairly suggests a system or method for measuring or computing ripple current by first detecting a current flowing through the voice coil motor, then integrating the detected current over a first time interval of the PWM cycle time to generate a negative current measurement; after that, integrating the detected current over a second time interval of the PWM cycle time to generate a positive current measurement and finally computing a difference between the negative current measurement and the positive current measurement.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Knight et al (USPN 6,639373) disclose supplying regulated voltage to VCM of a disk drive, particularly the VCM driver. Khersonsky et al (USPN 6,556,461) disclose a step switched PWM sine generator. Pedrazzini (USPN 6,373,650) disclose a voice coil motor control circuit having alternative modes of operation and method of operation thereof. Gradzki et al (USPN 5,973,437) disclose Tdead time and zero voltage implementation. Wu et al (USPN 5,767,638) disclose positive, negative and zero voltage switching implementation in an electric motor drive. Masuoka et al (USPN 5,663,846) disclose an actuator driving circuit for controlling loading and unloading a head slider.

8. Any response to this office action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 308-9051, (formal communications, please mark "EXPEDITED PROCEDURE")

Or:

(703) 308-6606 (for informal or draft communications, please label "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal Drive, Arlington. V.A., Sixth Floor (receptionist).

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fred Tzeng whose telephone number is 703-305-4841. The examiner can normally be reached on weekdays from 9:30 am to 6:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sinh Tran can be reached on 703-305-4040. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9306 for regular communications and 703-746-5710 for After Final communications.

10. Informal regarding the status of an application may be obtained from the Patent Application Information Retrieval (**PAIR**) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SINH TRAN
PRIMARY EXAMINER

Fred F. Tzeng

December 03, 2004